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Demonstration of Effective Management Option for Mole Rat of Enset in Kafa Zone

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Abstract
Enset (*Enset ventricosum*) cultivation has existed for several hundred years as a sustainable form of agriculture in Ethiopia. However, the sustainability of Enset based agriculture is threatened by a number of factors. The main biotic stresses are bacterial wilt, the Enset root mealy bug and mole rats. Mole rats (Spalax ehrenbergi) were reported as being as destructive of Enset as bacterial wilt. Mole rats can be controlled by using trap, chemicals and smokers. There are some botanicals plants that can repel the mole rats. In order to minimize mole rats attack, farmers of the study area were tried many option like directing flood and/or pouring water in to the mole tunnels, locally made traps and excavating the mole tunnels. But, they were not satisfied because of their less effectiveness and also need more human labor and time. Besides this – due to extreme mole rats attack on Enset farms at the study area – the farmers also lost their endeavors to control moles and they were obligated to replace their Enset farms by annual crops. Taking these in to account, the crop protection team of BoARC was demonstrated the fumigant aluminum phosphide to control mole rats on Enset farms in Kafa zone of **Adiyo** district at **Boka** and **Alarigeta** villages. The demonstration was conducted on a plot size of 10m x 10m at Enset farms of five farmers per village. The demonstration manifested that, the fumigant aluminum phosphide was a significant impact on mole rats mobility through the plots and the number of attacked Enset. Likewise, farmers of the study area were preferred aluminum phosphide rather than the practices they were familiar with in the past to control mole rats. In conclusion, aluminum phosphide was recommended for scaling up to minimize the damage of mole rats to Enset crops in highly mole rat prone areas.
Keywords: Aluminum phosphide; Enset; Management option; Mole rat

1. Background and Justification

Enset, *Enset ventricosum* cultivation has existed for several hundred years as a sustainable form of agriculture in Ethiopia [2]. More than 20% of Ethiopia's population depends upon Enest for food, fibre, animale forage, construction materials and medicines. However, the sustainability of Enset based agriculture is threatened by a number of factors. The main biotic stresses are bacterial wilt, the Enset root mealybug, nematodes, fungi and other vertebrate pests like mole-rats [1].

Mole rats are solitary animals that develop their own extensive tunnel system [4]. Individuals live alone and develop tunnels for feeding, for nesting and rearing offspring, for food storage and for sanitary disposal. Discharged mounded soil and heaved runways are indicators of this pest's presence [3]. The staff of the Hawassa Plant Health Clinic recently mapped one tunnel system which consisted of 29 branches with a total length of 140 meters and covering 50 square meters. After a period of tunnel use, especially the sanitary tunnel, an area may be walled off and not used again.

Mole rats were reported as being as destructive of *Enset* as bacterial wilt. Mole rats usually prefer and consume grass roots in open pastures with well drained soils but often thrive on weedy plant roots near fence rows and property boundaries, especially during the dry season [4]. With land pressures reducing the pasture areas, extensive feeding by mole rats on root crops and *Enset* has become prevalent. Some farmers have experienced the heartbreak of seeing their entire plantation succumb one by one to mole rats. Plants often become yellow at the top, drying and dying from the extensive root cutting and subsequent water shortage. Feeding on 1-3 year old *Enset* plants often results in complete loss of the root system and plants can be lifted out of the ground. Older and larger plants are often girdled and can remain alive but growth is retarded. Sometimes the "corm" (inside of the *Enset* plant) is tunneled in to the shoot meristem where the terminal leaf is cut off from its nutrient/water source.

Mole rats can be controlled by using trap, chemicals and smokers. There are some botanicals plants that can repel the mole rats. For example *Tephrosia vuglia*, if planted around the farm it repels the mole rats. Farmers in southern Ethiopia have different traditional methods to control mole rats. The farmers of Bonke district follow the biology of the mole rats to trap mole rat, where as farmers in Wolayta zone were used different way to trap the mole rat. Moreover, farmers of the study area (*Adiyo district; Boka and Alarigeta Villages*) were tried to control mole rats by directing flood and pouring water in to the mole tunnels, by locally made traps and by excavating the run ways or tunnels. However, the above mentioned options already practiced by the farmers were limited to control moles in the study area; due to high infestation of moles. Besides, consumed more time and human power /labor/. Indeed, due to extreme mole rat attack on *Enset* farms the farmers were lost their endeavors to control moles and they were obligated to replace their *Enset* farms by annual crops. As a result, *Enset* becomes out of

production. These indicated the need of a new approach to solve problems associated with mole rat. Therefore, the crop protection department of the centre was initiated to demonstration of aluminum phosphide fumigation. The aim was to minimize the mole rat attack on *Enset* crops in Kafa zone.

2. Materials and Methods

Demonstration of Aluminum phosphide to control mole rat in *Enset* farms was conducted at Kafa Zone; Adiyo District at two villages, namely Boka and Alarigeta. For implementation of the experiment first of all mole rat severity were assessed and five farmers were selected at both villages. Then after, awareness was created to selected farmers about how to use Aluminum phosphide fumigant to control moles. Finally, a plot size of 10m x 10m land per each field was demarcated in all selected farmers field at hot spot areas.

In fact, where a mole population has existed for some time, many tunnels might be unused or used irregularly. Therefore, endeavors were made to reduce the wastage of Aluminum phosphide by pre-treatment visit to level all molehills found per plot. Thus, after few days new molehills were found that were considered as active runs of moles. Probing materials; sharp tipped materials (metal/stick), were used to probe the tunnel/hole around the new molehills. When the hole/tunnel openings were found wiggle the probe to enlarge the opening (if the probe hole is not already large enough to allow passage of the aluminum phosphide tablets into the tunnel), and drop or insert Aluminum phosphide tablets into the tunnel. Immediately the tunnel openings were sealed up with rock/dirt clod or grasses and finally sealed by soil to eliminate light from entering and the toxic gases from exiting the tunnel. Once again, be careful not to bury the tablets with loose soil as this will render them ineffective. The key with aluminum phosphide treatments is to only apply when soil moisture is relatively high.

Moreover, for estimating the efficacy of the fumigant data of pre and post treatment counts (after 15 days and 30 days) of mounds/molehills and dead/damaged *Enset* crops per plots were recorded.

3. Results and Discussions

Both Boka and Alarigeta villages were the potential *Enset* crop growers in Adiyo district, but the *Enset* production was decreased and become out of production in some areas due to mole rat attack in near past. Thus, the farmers transformed their *Enset* fields to other annual crops.

Table 1. Effect of aluminum phosphide on mole rat activities

	Statistics						
	No. of pop. Of *Enset*	No. of MBTA	No. of MA15D	No. of MA30D	No. of DEBTA	No. of DEA15D	No. of DEA30D
Mean	41.30	9.80	1.80	2.30	3.20	.20	.00
Std. Deviation	23.608	5.007	2.044	3.164	1.549	0.422	0.000
Minimum	10	4	0	0	0	0	0
Maximum	96	15	6	9	5	1	0

Key: *pop. =population per plot, MBTA=Mounds before Treatment Applied, MA15D=Mounds after 15 Days after treatment applied, MA30D= Mounds after 30 Days after treatment applied, DEBTA=Damaged Enset before Treatment Applied, DEA15D= Damaged Enset after 15 Days after treatment applied and DEA30D= Damaged Enset after 30 Days after treatment applied.*

As shown in table 1, the minimum and maximum values of MBTA, MA15D, MA30D, DEBTA, DEA15D, and DEA30D were 4&15, 0&6, 0&9, 0&1 and 0&0; also, the mean values were 9.8, 1.8, 2.30, 3.2, 0.2 and 0 respectively. The demonstration confirmed that, number of molehills and damaged *Enset* per plot after the application of Aluminum phosphide fumigant were reduced. Moreover, mean values before treatment applied are greater than that of after application of the treatment for each variable. Mean value for the number of molehills before and after treatment applied were equals 9.8 and 4.1, and also for the number of dead and/or damaged *Enset* before and after treatment applied were 3.2 and 0.2 respectively. This indicates that, the fumigant Aluminum phosphide showed a promising effect on controlling mole rat in *Enset* farms of both villages.

Table 2 Farmers' perception about the control moles by Aluminum phosphide fumigation

	Perceptions	Adiyo (Alarigeta &Boka)
Farmers' opinion about the control of mole rat by Aluminum phosphide	Very good	100
When Aluminum phosphide was compared with those practiced by the farmers	Best	100

Table 3 Comments raised by farmers regarding Aluminum phosphide fumigation

Other opinions raised by farmers	Adiyo (Alarigeta &Boka)
Scale out this control option to farmers	33.3
It is better if supply of Aluminum phosphide will be available	22.2
Better if applied in whole farm	22.2
Good if such experiments is repeated	11.1
We need strong support to control mole rats	11.1

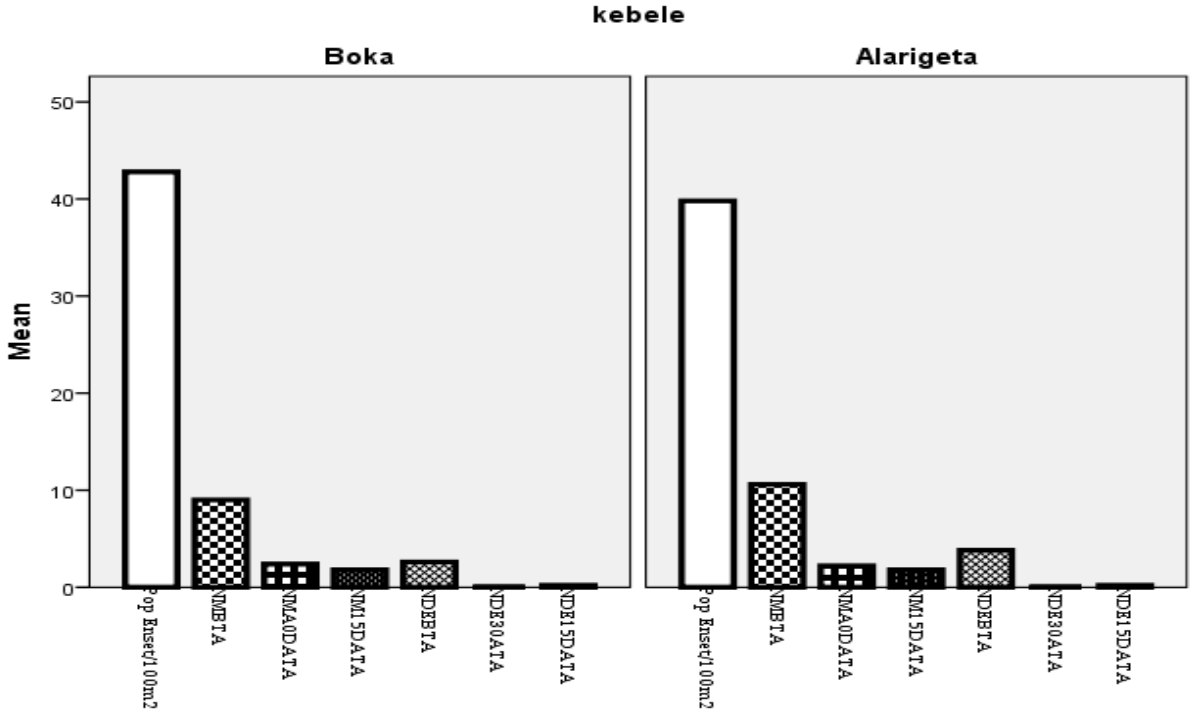

Fig 1. Effect of the fumigant aluminum phosphide on mole rat activity

3.1. Farmers Perception about the Control of Moles by Aluminum Phosphide

All of the farmers; where the experiment was implemented in their field, were responded Aluminum Phosphide is very good option to control mole rats in their *Enset* farms. They also gave their opinion, using Aluminum phosphide to control moles as the best option than other options that they were practiced before; such as digging of mole tunnels, directing of water and/or flood in to mole tunnels and use of traps to kill mole rats (table 2). Hence, Aluminum phosphide is the best option in controlling mole rats in *Enset* farms, 33.3% of the farmers were gave their ideas to reach this technology/control option to those farmers prone to mole rat problems. Further, 22.2% of the farmers were replied as it is better if aluminum phosphide will be available through Agricultural Development Office at District and/or Development Agents at village level for the future; like fertilizers.

However, 22.2% and 11.1% of the farmers shows less confidence about the control of moles by the fumigant Aluminum phosphide due to the appearance of new molehills near the demarcated area and thus they were replied, it is better if applied in whole farm and repeated again, respectively.

Table 4 Different method used to control Mole rats at the study area

	Traps	**Directing flood in to mole tunnels**	**Digging the tunnels to kill moles**
Boka	X X X	X	X X
Alarigeta	X X X	X	X X

3.2. Method Used to Control Mole Rat

Farmers of both villages tried to control moles in their farms by using traps, flood the tunnels, pouring water in to the tunnels and digging the tunnels. Trapping has long been recognized as a method of controlling moles and the technique is used widely in Boka village than Alarigeta village. Today, there are two types of traps in common on use, with a metal hook at the end and without metal hook at the end. Both are a rope traps designed to catch mole rats around the body when the trigger sticks rope is slashed releasing the killing mechanism. In both villages these control options are less effective than the newly introduced; fumigation by Aluminum phosphide, which was chosen as the best option to control mole rat by the farmers of both villages.

4. Conclusions and Recommendation

Mole rats are considered as the most harmful vertebrate pest which threatens *Enset* production in both villages. Farmers of Adiyo district (Boka and Alarigeta villages) experience the same control measures; using traps, flood the tunnels, pouring water in to the tunnels and digging the tunnels, but these control measures does not gave a good result. In general, the demonstration revealed application of aluminum phosphide had reduced the activity of mole rats at both villages. As well, all of the farmers; where the demonstration was implemented in their field, were responded aluminum phosphide fumigation is very good option to control mole rats in their *Enset* farms. They also gave their opinion, using aluminum phosphide to control moles as the best option than other options that, they were practiced before; such as digging of mole tunnels, directing of water and/or flood in to mole tunnels and use of traps to kill mole rats. Therefore, aluminum phosphide is recommended for scaling up to manage mole rats of *Enset* at mole rat prone areas.

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